SimOps

A Framework for Simulation Operations Automation

This framework integrates technology, best practices, and automation to enhance engineers' productivity while reducing the operational burden on IT teams.This whitepaper serves as a resource for understanding how SimOps can drive innovation, improve operational efficiency, and ensure data-driven decision-making across various industries and use cases.

This SimOps Framework whitepaper aims to provide a comprehensive guide to automating simulation operations, helping organizations streamline their simulation processes and optimize the use of high-performance computing (HPC) resources.

SimOps Framework

A Framework for Simulation Operations

1. Definitions

SimOps

SimOps is defined as the practice of automating simulation processes to significantly enhance engineers' productivity and contributions while alleviating the operational burden on IT teams responsible for managing complex high performance computing (HPC) environments.

SimOps Framework

SimOps is a structured operational framework that integrates cultural practices to automate simulation operations, optimizing the business value of simulation resources. It facilitates timely, data-driven decision-making and promotes operational accountability by enhancing the effectiveness of simulation use.

2. SimOps Principles

Simulations Drive Modern Product Development

Description: The modern landscape of product development increasingly relies on simulations to validate designs, test hypotheses, and accelerate innovation. Simulations provide critical insights that help engineers make informed decisions early in the product life cycle, reducing the need for costly physical prototypes and enabling faster iterations. (Process, Technology)

Require Simulation-Driven Decision-Making

Description: Decision-making is guided by simulation results, ensuring choices are based on comprehensive analysis and predictive insights. This approach leads to improved product performance and reduced time-to-market. (People, Process)

Cross-Functional Collaboration is a Must

Description: Encourage teamwork among engineers, IT, and business units to enhance simulation efforts and outcomes. Cross-functional collaboration breaks down silos, ensuring diverse perspectives contribute to the simulation process, enhancing the accuracy and relevance of simulation results. (People).

Automate Simulation Workflows

Description: Utilize automated processes to streamline and scale operations, enhance efficiency, and reduce manual effort. Automation minimizes the risk of human error, accelerates the simulation process, and allows engineers to focus on higher-value tasks such as analysis and innovation. (Process, Technology).

Achieve Operational Efficiency Using Hybrid-Cloud Practices

Description: Ensure operational flexibility to adapt to changing project requirements while maintaining consistency and repeatability in the user experience. This principle emphasizes the importance of centers of excellence or similar organizational structures that centralize SimOps expertise. These centers relieve product design and engineering teams from the operational burden of managing simulations and augment IT teams, who may lack specialized HPC knowledge, ensuring effective use of both standard enterprise IT services and specialized HPC environments. (People, Process, Technology).

Retain Control of Proprietary Data

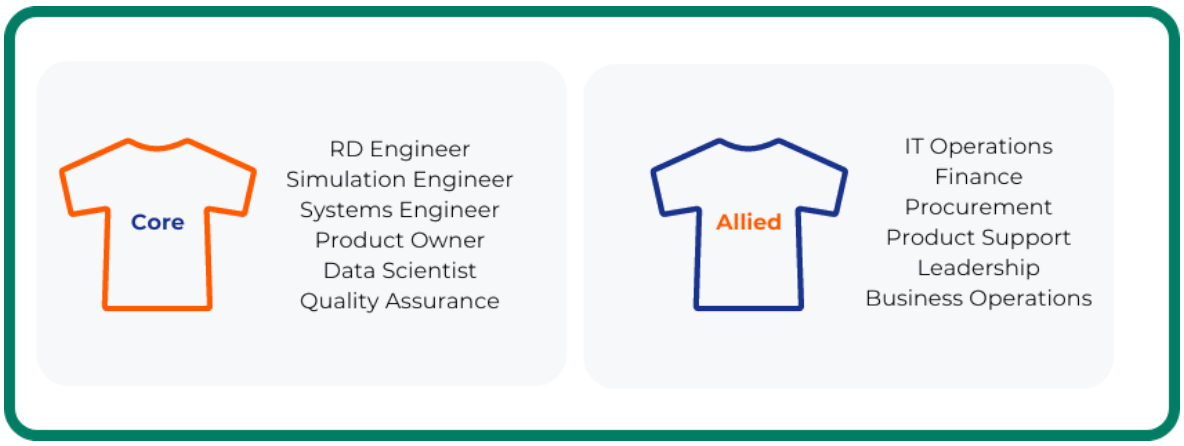
Description: Ensure that sensitive and proprietary data used in simulations is protected through robust security measures and compliance with data protection regulations. This principle emphasizes the importance of data governance and the protection of intellectual property, which is critical for maintaining competitive advantage. (Process, Technology).

Manage and Optimize Costs and Resources

Description: Implement strategies utilizing the cloud's variable consumption-based cost model to balance performance with cost-effectiveness, ensuring simulations deliver maximum value with minimal waste. Effective cost management ensures that simulation

activities are financially sustainable, leveraging cloud resources to optimize expenditure without compromising performance. (Process, Technology).

3. SimOps Core Personas



R&D Engineer

Scope:

- Utilizes simulation results to guide research and development activities.

Responsibilities:

- Driving innovation and product improvement using simulation data.
- Conducting experiments and simulations to validate new concepts and designs.
- Collaborating with cross-functional teams to integrate R&D findings into product development.

Simulation Specialist/Computational Engineer

Scope:

- Focuses on creating, running, and analyzing complex simulations, including mechanical and electrical aspects.

Responsibilities:

- Developing and executing simulation models to test product designs.
- Ensuring simulation accuracy, reliability, and relevance across various domains such as fluid dynamics, structural analysis, and electrical systems.
- Collaborating with product development teams to refine and optimize designs based on simulation results.

Systems Engineer/IT Specialist

Scope:

- Manages the infrastructure required for running simulations, including high-performance computing (HPC) resources and cloud platforms.

Responsibilities:

- Ensuring system reliability, performance, security, and scalability of the simulation infrastructure.
- Installing, configuring, and maintaining HPC and cloud resources.
- Monitoring system performance and troubleshooting issues to ensure smooth simulation operations.

Data Scientist

Scope:

- Analyzes data from simulations to derive actionable insights.

Responsibilities:

- Providing accurate and valuable insights from simulation data to support decision-making in engineering and business contexts.
- Developing data models and algorithms to analyze large datasets from simulations.
- Collaborating with simulation engineers and product managers to interpret data and suggest improvements.

Quality Assurance

Scope:

- Verifies the accuracy and reliability of simulation models and results.

Responsibilities:

- Ensuring quality standards are met through rigorous testing and validation of simulation outputs.
- Developing and executing test plans to validate simulation models.
- Collaborating with simulation engineers to identify and rectify issues in simulation accuracy and reliability.

Product Owner

Scope:

- Utilizes simulation insights to guide product development and lifecycle management.

Responsibilities:

- Aligning simulation efforts with product goals, ensuring market fit, and driving product innovation.
- Integrating simulation results into the product development process to enhance product features and performance.
- Working with cross-functional teams to ensure simulation insights are effectively utilized in product design and development.

4. Allied or Related Personas

Compliance and Security Officer

Scope:

- Ensures compliance with industry regulations and standards and secures the simulation environment and data.

Responsibilities:

- Maintaining regulatory adherence, data protection, and security protocols.
- Implementing security measures to protect sensitive simulation data.
- Ensuring that simulation practices comply with relevant industry standards and regulations.

Operations Manager (Product or Business Unit Role)

Scope:

- Integrates simulation results into operational processes to optimize performance and efficiency.

Responsibilities:

- Enhancing product development, operational strategies, and overall business performance using simulation insights.
- Coordinating with various departments to implement simulation results in operational workflows.
- Monitoring and improving operational efficiency through the use of simulation data.

Financial Analyst

Scope:

- Monitors the cost-effectiveness of simulation activities and bridges business, engineering, IT, and finance teams to optimize costs.

Responsibilities:

- Ensuring resource allocation aligns with budget constraints.
- Establishing best practices for cost management and financial accountability in simulation projects.
- Analyzing financial data to ensure simulation activities are cost-effective and provide value to the organization.

Procurement

Scope:

- Manages vendor relationships and the procurement lifecycle for software, hardware, and other goods and services.

Responsibilities:

- Ensuring cost-effective and timely procurement, managing contracts and vendor negotiations.
- Sourcing and acquiring the necessary tools and resources for simulations.
- Negotiating with vendors to secure favorable terms and conditions.

Product Support/Customer Experience Specialist

Scope:

- Provides support for products used by customers and integrates simulation insights to enhance customer satisfaction.

Responsibilities:

- Utilizing simulation data to identify issues and provide support to customers.
- Improving product usability and customer support strategies based on simulation insights.
- Working with engineering and product teams to address customer feedback and improve product performance.

Executive Leadership

Scope:

- Provides strategic direction and support for simulation initiatives.

Responsibilities:

- Ensuring alignment with organizational goals.
- Driving innovation and efficiency in simulation practices.
- Supporting investment and resource allocation for simulation projects.

IT Infrastructure Manager

Scope:

- Architects, deploys, operates, and optimizes IT infrastructure for simulations.

Responsibilities:

- Designing and implementing IT infrastructure for simulations.
- Ensuring cost-effectiveness and performance of IT systems.
- Maintaining and optimizing systems to support simulation activities.
- Integrating simulation infrastructure with broader IT and business goals.

5. SimOps Domains

Simulation Workflow Automation

- Workflow Orchestration and Automation: Automates complex sequences of simulation tasks to enhance efficiency and reduce manual intervention.
- Self-Service Simulation Management: Enables users to independently configure, run, and manage simulation projects without IT intervention.
- Design and Model Validation Tools: Provides tools to verify and validate models against predefined criteria to ensure accuracy before deployment.
- Digital Twin Integration: Incorporates real-time data into a virtual model (digital twin) to mirror and predict the performance of physical assets.
- Job Management: Manages the distribution and execution of simulation tasks across available computational resources.
- Integration with PLM and CAD Tools: Seamlessly connects simulation software with Product Lifecycle Management (PLM) and Computer-Aided Design (CAD) systems for streamlined workflows.
- Resource and Infrastructure Optimization: Ensures optimal use of simulation resources, including hardware and software, to maximize performance and minimize costs.
- Predictive Maintenance Modeling: Uses simulation to predict when maintenance should be performed on machinery to prevent unexpected failures.
- Enhanced Simulation Scope: System-Level Simulation: Extends simulation capabilities to encompass entire systems, rather than individual components, for more comprehensive analysis.

Data Management

- Data Collection and Storage: Captures and securely stores data generated from simulations for future analysis.
- Data Integration and Management: Integrates data from various sources and manages it to ensure it is ready for use in simulations.
- Data Quality and Integrity Assurance: Implements measures to maintain the accuracy and consistency of data throughout its lifecycle.
- Data Preparation and Preprocessing: Prepares and processes raw data to make it suitable for effective simulation.
- Real-Time Simulation and Feedback Loops: Incorporates real-time data into simulations to adjust and improve models dynamically.
- Post-Simulation Data Processing: Handles data after simulation to extract insights and prepare reports.

Compliance, Security, and Risk

- Compliance and Risk Management: Ensures that simulation practices adhere to applicable laws, regulations, and standards, and manages risks associated with simulation environments.
- Data Security and Access Management: Protects simulation data from unauthorized access and breaches.
- Disaster Recovery and Business Continuity Planning: Establishes protocols to recover from data loss or other disruptions and maintain business operations.

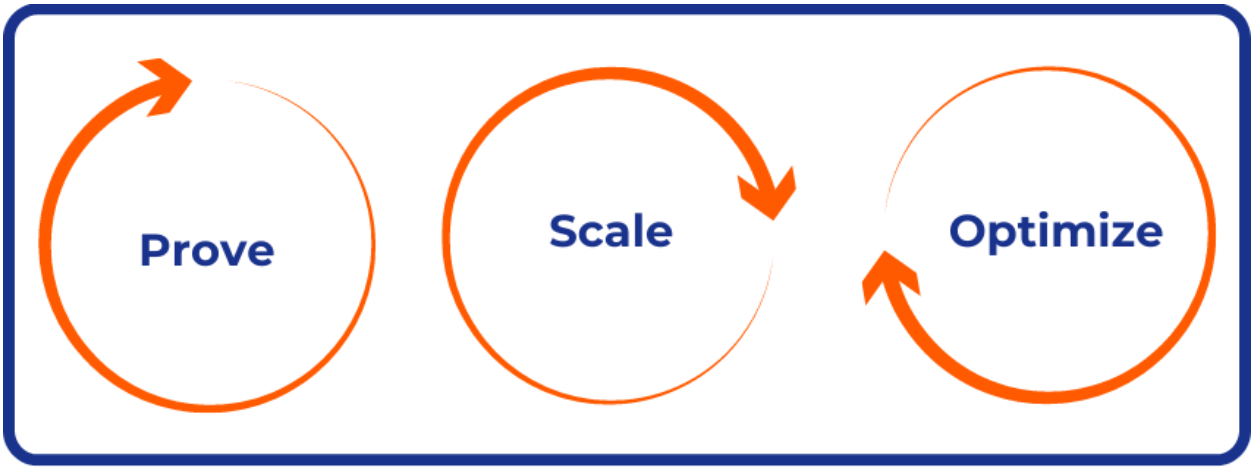
Reporting, Analytics, and Insights

- Advanced Reporting and Analytics: Delivers in-depth insights through sophisticated data analysis and reporting tools.
- Simulation Dashboards and Visualization Tools: Provides interactive tools to visualize and monitor simulation data and results.
- Machine Learning and AI Integration for Predictive Insights: Integrates AI technologies to predict outcomes and improve simulation accuracy.
- User Experience Monitoring: Tracks and analyzes how users interact with simulation tools to improve usability.
- Interdisciplinary Collaboration and Concurrent Engineering: Facilitates collaboration across different disciplines and stages of engineering simultaneously.
- Scenario Management: Manages different simulation scenarios to explore various outcomes and optimize decision-making.
- Advanced Simulation Objectives: Shift from Verification to Optimization: Moves beyond mere validation of models towards optimizing designs and processes through simulations.

SimOps Core:

- Governance and Policy Management: Sets policies for simulation practice and ensures compliance across the organization.
- SimOps Practice Operations: Manages day-to-day operations of simulation practices to ensure smooth functioning.
- SimOps Tools and Services: Provides essential tools and services to support simulation activities.
- SimOps Practice Assessment: Evaluates and improves the maturity and effectiveness of SimOps practices.
- License Management: Manages software licenses to ensure legal use and cost-efficiency.
- SimOps Onboarding: Introduces new users to SimOps practices and tools effectively.
- SimOps Education and Enablement: Provides training and resources to enhance skills and knowledge in SimOps.
- Sustainability in Simulation Operations: Incorporates environmental considerations into simulation practices to minimize the ecological footprint.

6. SimOps Maturity Levels



Prove (Crawl)

Definition: The Prove level establishes the feasibility of CAE simulations in various cloud environments (private, on-premise, public, hybrid) while ensuring no changes to the user experience.

Key Activities:

- Initial Use Case Implementation: Deploying a specific simulation workflow in the cloud to demonstrate feasibility and effectiveness.
- User Experience Consistency: Ensuring a seamless user experience across different environments.
- Enterprise-Grade Security and Compliance: Ensuring all cloud workflows, data handling, and resource provisioning adhere to security policies and compliance requirements.
- Performance Benchmarking: Conducting initial performance tests to validate computational efficiency, including CPU/GPU optimization, network latency, and clustering capabilities.
- Stakeholder Buy-In: Demonstrating the benefits of cloud-based simulations to gain organizational support.

Success Criteria

- Successful deployment and execution of targeted simulation workflows.
- Consistent user experience across environments.
- Compliance with security policies.
- Positive performance benchmarks.
- Stakeholder support.

Scale (Walk)

Definition: The Scale level involves expanding simulation operations across multiple workflows, users, teams, and geographies, focusing on efficient workload management and improved productivity.

Key Activities:

- Multi-Workflow Deployment: Extending simulation capabilities to support diverse workflows across various teams and locations.
- Operational Automation: Implementing automation tools to streamline operations and increase productivity.
- Resource Optimization: Dynamically allocating and optimizing cloud resources based on workload demands.
- Enterprise Collaboration: Cataloging and sharing proprietary workflows to foster collaboration and knowledge sharing.
- Scalability Testing: Ensuring that simulation operations can scale effectively to meet increasing demands.
- Performance Monitoring: Continuously monitoring performance to identify and address bottlenecks.

Success Criteria

- Successful deployment of multiple workflows.
- Increased productivity through automation.
- Efficient resource utilization.
- Improved collaboration.
- Verified scalability.
- Ongoing performance monitoring.

Optimize (Run)

Definition: The Optimize level focuses on refining and enhancing simulation operations to achieve peak efficiency, cost-effectiveness, and integration into broader design and planning processes.

Key Activities

- Advanced Optimization Objectives: Transitioning from basic verification to advanced optimization of designs and processes.
- Cost-Performance Balancing: Implementing best practices for optimizing the balance between cost and performance.
- Comprehensive System Simulations: Expanding capabilities to include detailed system-level simulations.
- Shift-Left Strategy: Integrating simulation and validation activities early in the product development lifecycle.
- Continuous Feedback Integration: Utilizing real-time feedback from testing and production data to continuously improve simulation accuracy and adaptability.
- Predictive Analytics: Employing predictive analytics to foresee and mitigate potential issues.
- Innovation and R&D: Leveraging simulations to drive innovation and support research and development initiatives.

Success Criteria

- Optimized cost-performance balance.
- Effective system-level simulations.
- Reduced development cycles.
- Continuous improvement.
- Enhanced predictive capabilities.
- Support for innovation and R&D.